UNITED STATES PATENT AND TRADEMARK OFFICE

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EXAMINER
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Please find below and/or attached an Office communication concerning this application or proceeding.

	Application No.	Applicant(s)
Office Action Summary	10/043,329	BAEK ET AL.
	Examiner	Art Unit
	Steven H. Rao	2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>06 May 2004</u>.

2a)☒ This action is **FINAL**.   2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23 and 51-58* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1-23 and 51-58* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on <u>29 April 2004</u> is/are: a)☒ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All b)☐ Some * c)☐ None of:

    1.☐ Certified copies of the priority documents have been received.

    2.☐ Certified copies of the priority documents have been received in Application No. _____.

    3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
    Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413)
    Paper No(s)/Mail Date. _____ .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

Response to Amendment

Applicants' amendment filed on April29, 2004 has been entered on May 06, 2004.

Therefore claims 1-23 as originally filed and recited in the amendment are currently

pending in the Application.

Claims 24 to 50 have been cancelled.

Claims 51 to58 are presently newly added.

It is noted that the page 9 of the amendment (remarks section lists claims 51 to 58 as

newly added claims , whereas the listing of claims pages 3-7 on page 7 list claims 57

and 58 as Original.

This discrepancy is noted and the correct notification as stated in the remarks section is

that claims 57-58 were previously non-existant and therefore presently are new claims

and not original as stated on page 7 of the claims.

Drawings

The drawings (sheets 1 and 2 of 18 , showing figures !A,B,C and 2A and B)

were received on April 29, 2004 . These drawings are accepted.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that

form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the
United States before the invention thereof by the applicant for patent, or on an international application
by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this
title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act

of 1999 (AIPA) and the Intellectual Property and High Technology Technical

Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting

directly or indirectly from an international application filed before November 29, 2000.

Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior

to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claims 1-3,6 ,13, 16-17, 20,22 and 24 are rejected under 35 U.S.C. 102(e) as

being anticipated by. Baluswamy et al. (U. S. Patent No. 6,514, 643, herein after

Baluswamy) . (The previous rejection has been reproduced below for ready reference-

for response to Applicants' arguments see section below)

With respect to claim 1 Baluswamy describes an overly key /comprising:

 a first overlay key having a first main overlay pattern (Baluswamy fig. 5, 210, col. 3 line

6) and a first auxiliary overlay pattern; (Baluswamy fig. 5 220, col. 3 line 4) and a

second overlay key having a second main overlay pattern (Baluswamy fig. 5 230, col. 3

line 6) and a second auxiliary overlay pattern, the second auxiliary overlay pattern being

formed at a location corresponding to the first auxiliary overlay pattern.(Baluswamy fig.

5 240)

With respect to claim 2 Baluswamy describes the overlay key of claim 1,

wherein the first and second overlay keys have a frame shape. (Baluswamy fig. 5, 210,

230).

With respect to claim 3 Baluswamy describes the overlay key of claim 2, wherein the

first auxiliary overlay pattern is formed at a corner portion of the first overlay key. (

Baluswamy fig. 5 220 formed in corner of 210).

With respect to claim 6 Baluswamy describes the overlay key of claim 1,

wherein the first auxiliary overlay pattern includes a plurality of bar patterns spaced

apart from each other. (Baluswamy fig. 5 220).

With respect to claim 13 describes the overlay key of claim 2, wherein the first

auxiliary overlay pattern is formed at a location adjacent to a corner portion of the first

overlay key. (Baluswamy fig. 5, 220 adjacent to corner of 210).

With respect to claim 16 describes the overlay key of claim 1, wherein the first

and second overlay keys have a substantially rectangular shape. (Baluswamy figure 5,

210, 230).

With respect to claim 17 describes the overlay key of claim 16, wherein the first

auxiliary overlay pattern is formed on a corner portion of the first overlay key. (

rejected for the same reasons as stated under claim 3 above).

With respect to claim 22 describes the overlay key of claim 21, wherein the first

main overlay pattern is defined by imaginary lines extended from two parallel outside

lines of the second main overlay pattern. (rejected for the same reasons as claim 5).

With respect to claim 24 describes and overlay key, comprising:

a first overlay key including a first main overlay pattern and a first auxiliary

overlay pattern; and a second overlay key including a second main overlay pattern and

a second auxiliary overlay pattern, wherein the first and second overlay keys are formed

at a location wherein a location of the first and second main overlay keys do not

correspond to each other. (Baluswamy figure 5).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 4-5,7-12,14-15, 18-19, 21and 23 are rejected under 35 U.S.C. 103(a) as

being unpatentable over Baluswamy et al. (U. S. Patent No. 6,514, 643, herein after

Baluswamy) as applied to claims 1-3 etc. above and further in view of Smith et al. (

U.S. Patent No. 6,573,986, herein after Smith)..

With respect to claim 4 Baluswamy describes the overlay key of claim 3.

Baluswamy does not describe a length of the first main overlay pattern is equal

to a length of a corresponding side of the second main overlay pattern.

However, Smith a patent from the same filed of endeavor describes in figure 1 a

plurality of box marks having a length of the first main overlay pattern is equal to a

length of a corresponding side of the second main overlay pattern to from high

precision overlay meterology tool for local measurements and extracts the global lens

distortion data in the described invented way the keep the error near unity and further

the overlay techniques can be used in conjunction with traditional methods to better

understand model and correct pattern placement errors.

Therefore it would have been obvious to one of ordinary skill in the art at the time

of the invention to include Smith's marks having a length of the first main overlay

pattern is equal to a length of a corresponding side of the second main overlay pattern

In Baluswamy's device to from high precision overlay meterology tool for local

measurements and extracts the global lens distortion data in the described invented

way the keep the error near unity and further the overlay techniques can be used in

conjunction with traditional methods to better understand model and correct pattern

placement errors. (Smith col. 6 lines 20-35).

With respect to claim 5 Baluswamy describes the overlay key of claim 4, wherein

the first main overlay pattern is defined by imaginary lines extended from two parallel

outside lines of the second main overlay pattern. (Baluswamy fig.5 210 parallel to

230).

With respect to claim 7 Baluswamy describes the overlay key of claim 6, wherein

the second auxiliary overlay pattern includes a plurality of hole patterns spaced

apart from each other. (Smith fig. 1).

With respect to claim 8 describes the overlay key of claim 7, wherein an interval between two adjacent bar patterns is larger than a width of the hole pattern. (Smith figure 1) .

With respect to claim 9 describes the overlay key of claim 6, wherein the second auxiliary overlay pattern includes a plurality of second bar patterns having a smaller width than the bar patterns. (Smith fig.1 big box b and small box A).

With respect to claim 10 describes the overlay key of claim 1, wherein the first auxiliary overlay pattern includes a plurality of hole patterns. (Smith figure 3).

With respect to claim 11 Baluswamy describes the overlay key of claim 10, wherein the second auxiliary overlay pattern includes a plurality of bar patterns. (Baluswamy fig. 5 , 240).

With respect to claim 12 describes the overlay key of claim 11, wherein a width of the hole pattern of the first auxiliary overlay pattern is larger than a width of the bar pattern of the second auxiliary overlay pattern. (Smith figure 20).

With respect to claim 14 Baluswamy describes the overlay key of claim 13, wherein a length of the first main overlay pattern is equal to a length of a corresponding side of the second main overlay pattern. (Smith figure 1, 14).

With respect to claim 15 Baluswamy describes the overlay key of claim 14, wherein the first main overlay pattern is defined by imaginary lines extended from two parallel outside lines of the second main overlay pattern. (rejected for same reasons as claim 5).

With respect to claim 18 describes the overlay key of claim 17, wherein a length of the first main overlay pattern is equal to a length of a corresponding side of the second main overlay pattern. (Smith figure 1, 14).

With respect to claim 19 describes the overlay key of claim 18, wherein the first main overlay pattern is defined by imaginary lines extended from two parallel outside lines of the second main overlay pattern. (rejected for the same reasons as claim 5 above).

With respect to claim 20 describes the overlay key of claim 16, wherein the first auxiliary overlay pattern is formed at a location adjacent to a corner portion of the first overlay key. (rejected for the same reasons as claim 13).

With respect to claim 21 describes the overlay key of claim 20, wherein a length of the first main overlay . pattern is equal to a length of a corresponding side of the second main overlay pattern. (Smith figure 1, 14).

With respect to claim 23 Baluswamy describes the overlay key of claim 1, wherein the first and second main overlay patterns are for measuring an overlay degree using an optical microscope, and the first and second auxiliary overlay patterns are for

measuring an overlay degree using an inline SEM (scanning electron microscope). (

Smith page 2 Hasan et al article).

Response to Arguments

Applicant's arguments filed April 29, 2004 have been fully considered but they

are not persuasive for the following reasons :

Applicants first contention that the applied Baluswamy reference does not

describe show an overlay key formed at a location corresponding to the first auxiliary

pattern is not persuasive because for the following reasons :

a)   Applicants' specification para 0017 states :

"The present invention also provides an overlay key including a first overlay key

including a first main overlay pattern and a first auxiliary overlay pattern, and a second

overlay key including a second main overlay pattern and a second auxiliary overlay

pattern, wherein the first and second auxiliary overlay patterns are formed at a location ,

where the first and second main overlay patterns do not correspond to each other." (

emphasis supplied)

Therefore when Applicants' claims are given their broadest interpretation in view

of their specification , the first and second overlay patterns need not correspond to each

other.

b)   Assuming Applicants' amend the specification so that the specification

agrees with the claims , Baluswamy col. 7 lines 1 to 5 and 5 to 10 state :

To minimize the misalignment of the second layer targets 630, 640 with the first layer targets 610, 620, the pitch P3 of the second layer targets 630, 640 should be designed to minimize lens aberrations. An exemplary method for determining the pitch P3 for second layer targets 630, 640 based on the light diffraction patterns of the first layer targets 610, 620 is described in FIG. 15 (process segments 520, 530, 540, 550). The first segment 520 of the method 500 is to select a pitch P2 for first layer targets 610, 620. The second segment 530 is to determine the projection lens locations of the diffraction orders generated from first layer targets 610, 620 as described in FIGS. 10–11. The third segment 540 is to

and abstract states :

There is a need and desire for a new method of designing feature dimensions, such as the pitch of second layer alignment targets, to minimize the impact of lens aberrations. Moreover there is a need to maximize the lens region overlap of light diffracted from two, different illumination shapes. Furthermore, there is a need and desire for a new method for determining the pitch of a second layer targets based on the pitch and light diffraction patterns of a first layer target that minimizes displacement of the second layer targets by lens aberrations due to changes in illumination settings.

SUMMARY OF THE INVENTION

The invention relates to a method of determining a dimension for a semiconductor feature, in particular a second layer alignment target's pitch, to minimize the impact of

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feature dimensions, such as the pitch of second layer align-
ment targets, to minimize the impact of lens aberrations.
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shapes. Furthermore, there is a need and desire for a new
method for determining the pitch of a second layer targets
based on the pitch and light diffraction patterns of a first
layer target that minimizes displacement of the second layer
targets by lens aberrations due to changes in illumination
settings.

SUMMARY OF THE INVENTION

The invention relates to a method of determining a
dimension for a semiconductor feature, in particular a sec-
ond layer alignment target's pitch, to minimize the impact of

lens aberrations during optical projection. In an exemplary
embodiment, the design method determines the pitch of a
second layer fine pattern alignment target based on the light
diffraction patterns of a first layer fine pattern alignment
target. The first layer target is designed to have a pitch
similar to that of a periodic feature of the integrated circuit,
such as a capacitor. The second layer target is designed to
have a pitch that minimizes displacement of the second layer
target by optimizing the light diffraction patterns of the
second layer target based on the first layer target.

Therefore contrary to Applicants' assertion Baluswamy teaches /describes wherein the

second auxiliary overlay pattern being formed at a location corresponding to the first

auxiliary overlay pattern.

Accordingly claim1 and dependent claims 2-3,6,13 16-17, 20 and 22 which were alleged

to be allowable because of their dependency from allegedly allowable claim1 are also

not allowable.

Applicants' second contention that Baluswamy's element 210/200 (in figure5) is

not a closed plane figure having four sides is not persuasive because Baluswamy in

col.5 lines 29-30 and col. 3 lines 40-45 state :

The displacement error is a function of the mechanical
placement capability of the system 20 and the projection
lens 30 aberrations. The mechanical displacement is the
same for both the pattern 120 and targets 110. However, lens
aberrations affect the pattern 120 and targets 110 differently.
In most cases, the lens induced error for the pattern 120 is
smaller than the lens induced error in typical box-in-box
targets 110. The lens error is more pronounced when dif-

and col. 5 lines 29-30 :

613. The targets 610, 620 are shown as two concentric
geometric squares. It is to be understood that other shapes,
number of targets, and arrangements are possible options, if
so desired. The first layer targets 610, 620 are separated by
distance P2, hereinafter called pitch P2. Ideally, pitch P2
should be close to the circuit's limiting dimension. such as

col. 5 lines 55-58

to be limited by the exemplary embodiment. Two concentric
boxes made up of thin lines are but one of numerous
configurations for alignment targets.

The above sections of Baluswmay clearly describe the targets (overlay pattern) can be

of any shape including box-inbox and geometric squares, both of which are closed

plane figures having four sides.

Therefore claim 16 is not allowalble.

Claim 22 was alleged to be not allowable because element 210 of figure 5 is not

defined by imaginary lines extended from two parallel outside lines of element 230.

However in figure 5 inside and outside lines of 230 (i.e. two parallel imaginary lines

extending from outside lines of element 230- second) define   210.

Therefore claim 22 is not allowable.

Applicants' contention that Claims 4-5,7-12,14-15, 18-19 21 and 23 are allowable

for reasons set out under claim1 above is not persuasive because as sated above the

agruements under claim 1 incorporated by reference here are not persuasive.

Applicants' second contention that there is no motivation to combine Baluswamy and

Smith is not persuasive because both Baluswamy and Smith describe/suggest lens

distortion error correction i.e. " A reticle including a 2- dimensional array of standard

overlay targets which are measured for placement errors " (Smith Abstract) and

Baluswamy   " A first layer alignment target 's pitch is selected based on the minimum

feature size of the circuit . The second layer aligment target's pitch is selected based on

the diffraction pattern of the first layers target" (Baluswamy – Absract).

As Baluswamy and Smith both deal with overlay targets ands reducing

placement errors the benefits of Smith reproduced below : (col. 6 lines 20-35).

> ⁰   Because the technique utilizes a high precision overlay
> metrology tool for local measurements and extracts the
> global lens distortion data in a unique way means the
> metrology error multiplier is kept near unity. In addition, the
> technique can be used in conjunction with traditional over-
> ⁵ lay techniques to better understand, model and correct
> pattern placement errors. Additional applications of the
> above outlined procedure include: improved lithographic
> simulation using conventional optical modeling software,
> advanced process control in the form of feedback loops that
> ⁰ automatically adjust the projection lens for optimum
> performance, and reticle correction algorithms that compen-
> sate for lens aberration. The technique forms a self-
> referenced methodology that does not require a special set of
> overlay calibration wafers or assumptions concerning the
> ⁵ placement accuracy of the stage.

directly deal with and provide a solution to the overlay key alingment and reduction of

any distortion caused while trying to aling the two overlay keys.

Applicants' contention that they have no knowledge of what is disclosed in the

provisional application from which Smith claims priority is an irrelevant issue.

A U.S patent has presumption of validity and the fact that priority is granted is

sufficient presumption that at least what was disclosed in the non-provisional

Application was also disclosed in the provisional Application also, in order to be entitled

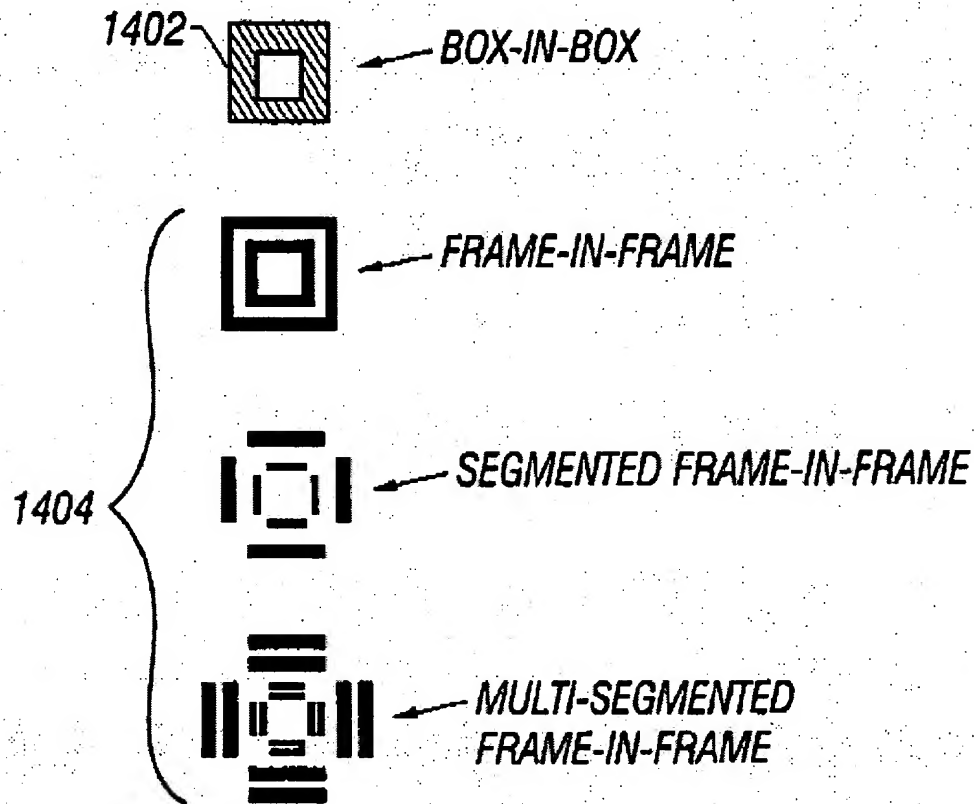to the priority as indicated on the face of the Smith patent .

Therefore the Office has meet its initial burden of prima facie showing of Smith's earlier

filling date than the present Application.

If Applicants' have any doubts they can easily verify or dispel their doubts by ordering

the provisional Application which is available to the public because it is mentioned in

the issued Smith patent.

        Applicants' contention with regard to claim 4 is based on confused understanding

of the outstanding rejection. Further Smith's entire disclosure including mention of

large/smaller boxes will make it clear that it is referring to first and second overlay

patterns.

        The same reason (as stated under claim 4 above) has been repeated with

respect to claims 4-5, 8-12 and 20 and is not persuasive for reasons set out above..

Applicants' arguments with respect to claims 14,18 and 21 that Smith figure 14 does not

appear to show a length of first main overlay pattern is equal to a length of a

corresponding side of the second main overlay pattern is at odds with figure 14

reproduced below – see especially the multi segmented frame-in-frame wherein first

and second pattern are identical forming a square.

Typical overlay patterns or completed alignment attributes

1402 — BOX-IN-BOX

1404 {
— FRAME-IN-FRAME

— SEGMENTED FRAME-IN-FRAME

— MULTI-SEGMENTED
FRAME-IN-FRAME
}

FIG. 14

Therefore claims 14,18 and 21 are not patentable over the prior art.

Claims 15 and 19 were alleged to be allowable because Baluswamy allegedly does not

disclose imaginary lines extending from two parallel outside lines is not persuasive for

reasons set out under claim 22 above and incorporated herein by reference.

Applicants' arguments with respect to claim 23 are not persuasive because claim

23 was rejected as Sem being a well known apparatus used to measure overlay

patterns and as proof of well known apparatus Hassan was cited. Therefore there is no need to include Hassan because it was cited to show what is well known to one of ordinary skill in he art.

New claims 51 to 58 are presented for the first time and are rejected for reasons set out above.

Therefore all pending claims are finally rejected.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communication from the examiner should be directed to Steven H. Rao whose telephone number is (703) 306-5945. The examiner can normally be reached on Monday- Friday from approximately 7:00 a.m. to 5:30 p.m.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 308-0956. The Group facsimile number is (703) 308-7724.

Steven H Rao

Patent Examiner

July 23, 2004.

Wael Fahmy

SPE 2814